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From Nebula to Nation

The Story of Evolution

An Address
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This address is an attempt to tell the story of evolution in a manner so simple as to bring it within the range of every one's understanding. Of course, it makes no attempt to treat so large a subject adequately, but hopes to move people to make a more exhaustive study of this fascinating story. It is printed for the sole purpose of reaching a larger audience than can be accommodated in the Unitarian Church.

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The Story of Evolution



About a year ago I spoke to you on the subject: "Is Evolution a Fact or Only a Theory?" and we came to the conclusion that evolution is a fact. I showed that all of the eminent scientists of the world have accepted the doctrine of evolution as the basis of all their study and investigation. I reviewed for you the evidence in its favor and we came to the conclusion that in the face of this evidence, it is impossible to question the truth of the evolutionary doctrine. This morning we shall be in no way concerned with this evidence. We shall assume the fact that evolution is true and address ourselves to the path it has followed. In other words, I shall relate as simply as I know how the story of the development "from nebula to nation." Before beginning this story, however, it is necessary to be sure that we know what evolution means, so let me ask, without going into detail as to the answer, "What is evolution?" We all know the famous definition of it given by Herbert Spencer: "An integration of matter and concomitant dissipation of motion, during which the matter passes from an indefinite, incoherent, homogeneity, to a definite, coherent, heterogeneity, and the retained motion undergoes a parallel transformation." I presume this definition is all right for scientific scholars who are acquainted with the foreign language of science in which Mr. Spencer speaks, but there is a much shorter and easier definition for those of us who do not speak the same language as Mr. Spencer, which expresses its central idea equally well. It is this: Evolution means growth. Evolution is simply the doctrine that everything which now is or ever was or ever will be, including the universe itself, is the outcome by natural laws and forces of all its preceding states. It is simply applying to the universe as a whole the principles which we

know to be true of flowers and trees, of animals and men. It merely teaches that everything grew; earth and oak, universe and animal, solar system and soul.

For centuries mankind had believed in special creation, that men and animals and plants had been created in the beginning by the hand of an almighty god, exactly in the form in which they appear today; and that through all the years that have passed from the first morn of creation down to the present time, these various animals and plants have lived and died and propagated themselves without any change of structure whatever. This theory of special, divine creation was accepted by practically all of the people of the world, with a few exceptions, down to the publication of Charles Darwin's "Origin of Species." And this hypothesis was accepted, not because it was based upon any observed facts, but simply because it was a venerable speculation which in the absence of any facts to the contrary seemed to be a fairly satisfactory answer to the problems involved. The evolutionary idea is very old, going back to some of the Greek philosophers, but it is only since the days of Charles Darwin, who gave the world the facts to prove this theory, that it has become an essential part of our mental equipment. It is now an everyday intellectual tool. It was applied to the origin of the solar system and the making of the earth before it was applied to plants and animals. It was extended from these to man himself. Then it spread to languages, to institutions, to governments, and to religions. Within recent years it has been applied to the chemical elements and likewise to the mental world as well as the physical. In fact, it is today universally applied—everything that exists is the result of the development from preceding states by natural laws and forces.

Origin of the Solar System

And now for the story which tells in a general way how this development took place. This story is to be found in the four sciences of astronomy, geology, palaeontology and anthropology; and any of you who wish to follow it more in detail can do so by studying these four branches of knowledge. Astronomy long ago exploded the idea that the earth was the center of the universe, with sun, moon and stars revolving around it for the sole benefit of man. It teaches rather that the earth is a planet revolving around the sun, from which it receives heat and light. Besides the earth there are seven other large planets which also revolve around the sun. Some of these planets have smaller bodies called moons or satellites revolving around them. For instance, Jupiter has eight moons, while the earth on which we live has one. There are, besides the

eight big planets, several hundred much smaller ones, called planetoids, which means "little planets." This arrangement of planets and planetoids moving around the sun is called the solar system. A glance at the sky on a clear night reveals an enormous number of stars which appear as mere specks of light. Their great distance from the earth running into trillions and trillions of miles prevents any estimation of their size. Their number, that is those which come within range of the telescope, about 2,000 million, and the greater part of them are known as fixed stars because they retain the same position in respect to one another. Now these fixed stars are like our sun and shine with light of their own. Their distance from us is so great that although many of them are much larger than our sun they appear to us only as twinkling points of light. The planets of our solar system shine, too, but their light is reflected from the sun and therefore not their own, although it is possible that some of the bigger planets have not yet entirely cooled and possess some light of their own.

Also scattered through the heavens are certain misty patches of light which for many centuries perplexed the astronomers, but we now know what these are. They are luminous masses in a state of great heat and are called "nebula," meaning a cloud, and some 200,000 of them are known in various parts of space. It was from just such a cloud that our solar system evolved. Opinions are divided at present as to whether these nebulae are composed of gas or solid particles, there being three main theories. Some scientists believe the cloud to be composed entirely of gas; others maintain that it began as an immense swarm of meteors; and still others hold that the nebula consists of a cloud of solid particles supposed to have come from an explosion as the result of a collision of two dead stars. Which of these three theories is correct means very little, as it is undisputed that star systems or solar systems are evolved from nebulae. This process is practically as follows: The material of the nebula for some reason begins to revolve and continues in constant motion around its center, like water stirred in a basin, gradually splitting into revolving rings, one within another, around a central mass. The rings gradually break up into masses until the nebula at last becomes a number of planets whirling rapidly around a central mass or sun. Such an arrangement is called a star system. There are many of them in the heavens, their suns being the fixed stars of which I have already spoken. Our solar system is one of them. They are in all stages of development from nebulae to complete systems, and there are some which by the gradual loss of energy and the slowing down of their revolving motion have become cold and dead. Our moon is an example of

this kind. Originally a part of the earth which split off in the early days of the formation of our solar system, it gradually gave up its heat until it became cold and dead.

The Cooling of the Earth

Here geology takes up the story. The earth, once formed as a planet in the evolution of the solar system, was first a mass of intensely hot material which cooled very slowly as it circled year by year around its source, until a solid crust formed upon its surface. This thick outer crust formed the hard surface commonly known as land. Besides this land, however, there is on the earth a great quantity of water in the form of oceans, lakes, and rivers. While the globe was in the hot stage it was surrounded by a dense mass of steam and as it cooled this steam cooled with it and condensed into water. In cooling, of course, the earth contracted or shrunk and with this shrinking the surface was thrown into wrinkles like the skin of a dried apple, forming deep hollows in which the water collected, so that finally the earth became a ball covered with land and water. Even when the earth had thus assumed the form which resembled its present condition, long ages passed before life appeared upon its surface; and it was in the water that life eventually had its beginnings. The details of the process of cooling and the changes that have taken place in the surface of the earth must be sought in a work on geology.

This brings us to that stage in the development of existing things which is revealed by the study of palaeontology, which comes from two Greek words meaning "ancient being." Finally, when the earth had reached a stage when life could exist on it, life began. There are many interesting speculations as to how this life began, but I have no time to discuss them this morning. These living things from the beginning have left their records in what are known as fossils, meaning to dig up, a name given to them because they are dug out of the earth's crust in which they lie. These fossils may be the stems and roots of trees, leaves, shells, parts of insects, bones, or foot prints of birds and animals, and so forth. From these remains the palaeontologist reconstructs the kind of life that existed in ages past, and this brings us to what is more specifically known as the theory of evolution as discovered and taught by Charles Darwin and his followers, that is, the story of the development of life from its lowest to its highest forms.

The Laws of Evolution

As I suggested a moment ago, until the middle of the last century it was believed that all of the different species

of plants and animals were created separately, man being made last of all; and that species therefor are immutable, unchangeable. But Charles Darwin showed this to be an **error, and that the various species or kinds of plants and animals now living, including man, were formed gradually by means of the accentuation and perpetuation of variations in the individuals of a species.** The process took an immense time and was due to certain natural forces which are always at work. Darwin, arguing from what men can do by artificial selection in breeding domestic plants and animals, pointed out that nature could, infinitely more slowly of course, do the same by natural selection. And the natural forces which bring these changes about have been classified as the five laws of Darwinism, which I will state very briefly.

The first is the law of heredity, which means that like produces like—cats do not produce dogs, and dogs do not produce cats—but each produce their own kind. That is to say, the young of any animal resemble their parents. The same law, of course, may be applied equally to plants. The second is the law of variation. No animals, even those that belong to one kind, are exactly alike; nor are they exactly like their parents. In a litter of kittens no two are precisely the same; even when they resemble each other in color there are differences in their markings. This holds true all the way up to man—no two children of the same parents are exactly alike; even when they look very much alike they differ in temperament. The third law may be stated thus: More of all kinds of plants and animals come into being than can possibly live. There is an almost unlimited number of offspring, even from those animals which reproduce the slowest; and at the same time there is a limited food supply upon the earth, so that the great majority of those plants and animals born must die before they reach maturity. And this leads to the fourth law, the struggle for existence, which is going on continuously. Every plant or animal that comes into the world must struggle or fight for food and other necessities in order to live. And the outcome of this struggle is the fifth law, namely: the survival of the fittest, that is to say, the beings that are strong enough to win food or that can best stand the conditions in which they live, that can adapt or fit themselves best to their environment, are the most likely to go on living and reproducing their kind, the advantage which makes it possible for them thus to adapt themselves to their environment coming as the result of the variations which we spoke of in the second law.

It is the continual working of these five laws that has filled the world with the plants and animals which live

upon it today. There have been considerable variations to these laws, some of them have been amended and supplemented as a result of more recent observation and experimentation, but fundamentally they remain the basis of evolution. Throughout the long ages since life first came upon the earth various kinds of animals have been evolved and have died out because they were unable to fulfil some or all of these laws. That is to say, better kinds of animals took the place of others because these new forms could more easily obtain food or withstand changes in climatic conditions. Possibly in the course of time these also failed to adapt themselves to fresh alterations in their surroundings and so died out and gave place to others. How the present animal population of the world came about must now be briefly sketched in order that we may know how man came into existence.

The Beginnings of Life

The form in which life first appeared was that of a jelly-like substance called protoplasm, which means "first moulded." This jelly-like stuff is the foundation on which all life depends; it is the basic material of all plants and all animals. The simplest animal consists of a mere speck of protoplasm containing a round body within called a nucleus, the whole so small as to require a compound microscope to see it. Such a speck of protoplasm with nucleus is called a cell. All animals consist of either one or many cells. Man himself is a creature built up of an untold number of cells, somewhat as a house is built up of bricks, although different, of course, since man is an organism. The simplest one-celled animal is called protozoa, meaning "first animal," and many celled animals are called metazoa, meaning "later animal." These protozoan animals consist of merely one cell, but have the power of movement, irritability, taking in food, throwing off waste matter, and reproducing themselves by division. The first metazoa were very simple in structure, such as sponges, corals, jellyfish and the like, animals with very few more attributes than protozoa itself. The next animals were wormlike, and from them branched off molluscs, such as oysters, snails and cuttlefish, and crustacea, such as lobsters, crabs and shrimps, also insects which have developed into multitudinous forms. Then came an extremely interesting group of animals which showed a new character, the forerunner of a great change of form. Up to this time all animals had soft bodies without bones, although many of them, like the oyster and lobster, had developed shells to protect them. This new group had a gristly cord running through the body called the notocord, meaning back-string. This is the beginning of a backbone which came to be formed of a number of bones called vertebrae. The in-

teresting little creature with the notocord is a lance-shaped animal called the lancelet. From this lancelet came the fish, first those with merely a gristly backbone like the sharks, and later those with a skeleton of bone like the salmon and the cod. From then on the animals all have backbones. Thus there are two great divisions of animals, the vertebrates or those with backbones, and the invertebrates, or those without backbones.

The Vertebrates

Then appeared certain fish which became especially adapted to a life in mud, as the water began to dry up and left land exposed. Instead of breathing like other fish from slits in the side or gills, they developed lungs for the purpose of breathing air, so as to meet successfully the struggle for existence; hence they are called dipnoids, meaning "double-breath." From these double-breathing fish were evolved the amphibians, meaning double-life, animals able to live on land or in water, such as the frogs. From these came the reptiles, meaning to crawl, which lived entirely on land and breathed air instead of water, such as the snakes. A branch of the reptiles developed into birds, but we have no time to follow these various branches—we are following the main stem of the tree of life which blossoms into man.

From the reptiles came the mammals, meaning breast, which nourish their young by means of milk. The first of these were curious creatures which, like reptiles and birds, laid eggs, specimens of which are still found in Australia and New Guinea. From the egg-laying mammal came the pouched mammals called marsupials, meaning "a little pouch," which gave direct birth to their young but at an immature stage, and which carried their immature off-spring in a small pocket in the skin. The kangaroo is the best known example. From the marsupials came a number of branches, but again we are interested in only one of them. This is the group of little tree-living animals called lemurs. From the lemurs sprang the apes and monkeys, and what is more important, man himself. Precisely through which branch man was evolved is not yet fully determined, but it is probable that one ape-like ancestor gave rise to branches from which came the gorilla, the chimpanzee, the orang-outang and the ape-man. Thus by means of evolution the whole series of animals ending in man himself came into being. The process has taken an enormous time. From the facts which astronomy, geology, and palaeontology have revealed it is estimated that at least eighty millions of years went by from the time when the earth was split off from its parent nebula until man first appeared. It is believed by some to be much

longer than that, but this period is considered to be the shortest in which the process could have taken place.

The Origin of Man

But we are still more interested in the evolution of man himself. Like other animals the primitive men who existed long ages ago have left fossils behind them. Skulls and other bones have been found in caves or in the gravels of ancient river-beds, so that anthropologists have been able to decide with considerable accuracy what these ancient men were like. I have time for only a very brief notice of these primitive men, but reference to any of the noted recent books on anthropology, such as, for instance, "The Antiquity of Man" by Sir Arthur Keith, will show that from an examination of fossil skulls men of modern type have existed for an enormous age, which puts back the period of time necessary for his evolution from his ape-like ancestors to a very remote date. Sir Arthur does not consider a million years too great an estimate. But besides his bones, which decay easily so that only a few of them are found, man has left behind him the implements that he made and used, axes and spears, hammers and knives. These are mostly fashioned out of flint or other stone, for it was a very long time before men knew the use of metals.

The general consensus of opinion is, though this cannot be definitely determined, that the locality in which man first appeared was somewhere in the Indian Ocean, where land has been submerged since man was first evolved, although not within historic times. The earliest men were probably very unlike any of the people, even the lowest savages, that exist today. They resembled much more, although they were also different from them, the apes, gorillas, and orang-outangs. They lived in caves, ate fruits and nuts, and probably used as weapons sticks and stones picked up at random. Later they made their implements out of flint which they shaped roughly by chipping. They existed for long ages in this condition, but as time went on they grew gradually more skilful and the implements they made showed better workmanship. At some period they became acquainted with the use of fire; how or where this happened is unknown. It is believed by many to have been from the accidental firing of dead trees or dried grass by lightning, some of which burning stuff they may have saved to keep a fire going for the sake of warmth. But what is more important, they learned at some time or other to make fire for themselves, probably by rubbing two sticks together or by striking two pieces of flint against each other, as some savages do today. With better weapons they took to hunting, and being able to make fire

they cooked and ate the animals they killed, using their skins for clothing to keep them warm. The cavemen even possessed the art of drawing, for in this period we find pictures of animals sketched on pieces of ivory or slate, as well as on the walls of caves.

The Stone Age

Later, after about 600,000 years of slow progress, man had improved. He had learned a great deal by experience, that is, by the trial and error method. He had very slowly developed a kind of speech so that he was able to hand his experiences on to his children. Consequently, his existence gradually became easier and he began to live more comfortably. He still made weapons and implements of flint and stone, but ground their edges and polished their surfaces. He made bows and arrows, too, and hammers and picks of stag's horn. He had learned to weave cloth for garments and to make pottery to hold food and water, and at some time in this period he began to cultivate a kind of grain. One of the most important things he did was to train the dog which has been the friend of man ever since. This probably was the result of making friends with stray wolves. Later man domesticated cattle and still later horses, so that his range of movement was greater and more work could be done. This early stage of man's progress is called the Stone Age, and is divided into the older stone or palaeolithic age, and the later or more advanced stone or neolithic age. It is now generally agreed that before the palaeolithic there was an eolithic age when man made the very roughly chipped flints recently found in the remains of ancient river gravels in England. Moreover, there must have been a still earlier period when he had not even reached the stage of flint work. These are known as the Stone Ages of man. It is important to remember that they do not refer to periods of time, but to degrees of advancement.

The Bronze Age

At last man discovered metals and when this happened they began to go ahead much faster. At first they used copper but this metal was much too soft to be serviceable, so they soon learned to mix it with tin and thus make bronze. With the Bronze Age much greater progress was made. Men began to live together in larger numbers than before. During the Stone Age the cave-dwellers had gradually given up their caves for rough huts. Then two or three huts had grown into a collection big enough to be called a village. For a long time men thus lived in village communities, sometimes built out over a lake upon piles to be more secure. With the Bronze Age many of

these village communities expanded into towns, and some of the towns into cities. The simple huts had been gradually replaced by houses which during the age of bronze became in time more and more elaborate until they reached the size and stateliness of the dwellings found in Egypt, Assyria, Rome, and Athens. All of this took of course, a very great deal of time, and was only a part of the gradual advances made in skill of workmanship and comfort of living. As soon as the village communities reached any size, men began to depend more upon one another. Thus classes like those of fisher, hunter, weaver and flint worker, gradually began and the foundations of social intercourse and social order were laid. Men found that when they wanted something that some other man could make more successfully than they, it was better to offer him for it things he could not make so well, than to waste time trying to make it for themselves. So barter came about. In order to simplify matters a medium of exchange was later invented in the form of money; and out of this grew our whole intricate system of commerce and industry.

Thus life became more complicated and language developed enormously. With this increasing complexity of the Bronze Age there came about an invention which was necessary with the greater social intercourse and the beginnings of trade and commerce. It was something that made a greater change in human life than had ever been before or has ever been since. This was the invention of writing whereby it was not only possible for men to communicate with other men at a distance, but it enabled men to put on record the things they did and the thoughts they thought, so that those who came later could read what their forefathers had done and had known. Thus knowledge did not die altogether with its possessor and the wisdom of generations began to accumulate. The immense value of this to man's progress can easily be imagined. Of course, it must be remembered that the art of writing was not invented all at once, as the ancients thought. It grew by evolution from small beginnings, like everything else. It is quite impossible to say in what age writing began because its evolution must have been very slow and gradual. As a matter of fact one might say that the first caveman who thought to pick up a sharp flint and scratch upon the cavewall a rough outline of a bear he had seen, was the inventor of writing, for the alphabet from which all of our words are formed had its origin in pictures, and the earliest known writing was picture writing. So the art of writing probably took thousands and thousands of years to develop.

The Iron Age

Last of all iron was discovered, another event which meant a very great deal to man's advancement. All the wonderful machines and inventions which seem a matter of course at the present day became possible through the discovery of iron and of how to work it. Thus, just as the earth has passed through all the stages from the nebula to the present day distribution of land and water, and just as life has progressed from the single-celled protoplasm to the complicated physical form of a mammal, so has man progressed from the use of sticks and stones to the use of engines and automobiles and aeroplanes. These stages of man's evolution are known as The Stone Age, The Bronze Age, and The Iron Age; and it is in the Iron Age that we are living. Naturally the more skilful man became the better weapons and implements he made and the faster he moved forward. It is certain that he improved much more rapidly in the neolithic age than in the palaeolithic and still more rapidly during the Bronze Age. So far as is known at present about 600,000 years passed between the first ape-like man and the end of the Stone Age, and only about 30,000 years between that and the termination of the Bronze Age. These computations are only approximate and are probably under rather than over-estimated. So far the Iron Age has lasted a little over three thousand years. If these three periods be added together the shortest time in which man could have existed upon the earth is about 633,000 years, a period very different from that assigned by those whose only foundation for their conclusion existed in their imaginations. Under the old ideas man had less than 6,000 years to achieve his present condition, but the men of science assure us that not only did man progress very slowly but that he has had at least one hundred times longer to do so than was formerly believed.

But when we talk of the progress of man from the earliest times to the present, it must not be thought that all men have progressed at the same rate. There have been ups and downs, old civilizations have been destroyed or died out and new ones have arisen. There are races of men today who have never risen above the primitive state. In Africa, Australia and the South Sea Islands are savages who still use stone implements. They are the stragglers who have dropped out in the long wanderings and migration of primitive peoples before civilization was attained. They have not advanced either because they were incapable of improvement or because they were cut off from the advantages enjoyed by other races. By the study of these peoples we gain some conception of what our far-off ancestors were like, and we can recognize the

consciousness, but fundamentally it is the same thing on a larger scale, for now the nation became everything to its members and all other nations were considered enemies. This is the stage of social evolution in which we are now living, and that is why I called this address "From Nebula to Nation." But this does not mark the end of the evolution of our social organization, for beyond the nation is the world, and beyond the people of one country is the great circle of humanity. And just as in the early days the individuals found that mutual co-operation and assistance was necessary to the existence of the tribe, as later this mutual co-operation and assistance was extended to many tribes or the nation, so in the future we will find that it is necessary that this mutual co-operation and assistance be extended to the world, if humanity as a whole is to survive. So that the next step in the evolution of social organization will bring us to the day when men shall recognize that our first and highest duty is to mankind as a whole and not to any single section of mankind. In fact, we are beginning today to develop this world consciousness, what some one has called (and I love the term) "planetary consciousness," the consciousness which recognizes that here we are on this little planet and that it is disastrous for us to be divided up into antagonistic groups, while it would be greatly to our benefit to be bound together in a spirit of universal co-operation. And I feel sure that the day will come when all men will feel what some men now feel, what has been called "the enthusiasm for humanity, which extends its sympathies to human beings not because of any particular relationships, nor because they live in the same country with them, but because they are men and live on the same planet with them; and then men instead of wasting their efforts fighting one another while being devoured by their common enemies such as ignorance and poverty and disease, will unite in peace and harmony for the overthrow of these common enemies. And for this time, as Mr. Van Loon suggested on Thursday evening, we must not be impatient. Astronomical mathematicians assure us that this little planet has still another ten million years to go before the sun grows too cold to sustain human life, barring accidents, of course, such as a collision with some dead star. So if man has reached his present condition in one million years, he still has great opportunities ahead of him. But it must be remembered that his present position was reached through the development of brain power and the acquisition of knowledge, and his future development will depend upon the same thing. Knowledge is the thing men need—knowledge, and that which comes as the result of knowledge—understanding, sympathy, and mutual helpfulness.